

# Integrating satellite precipitation estimates into the Global Fire Weather Database

Robert Field

Field, R.D., A.C. Spessa, N.A. Aziz, A. Camia, A. Cantin, R. Carr, W.J. de Groot, A.J. Dowdy, M.D. Flannigan, K. Manomaiphiboon, F. Pappenberger, V. Tanpipat, X. Wang, Development of a Global Fire Weather Database, *Natural Hazards and Earth System Sciences*, 15, 1407-1423, doi:10.5194/nhess-15-1407-2015, 2015.



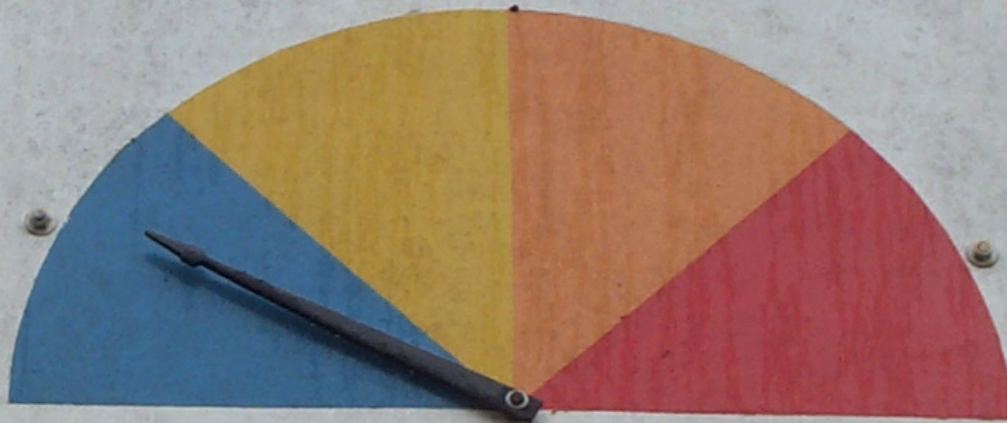
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New York, N.Y.



**COLUMBIA UNIVERSITY**  
IN THE CITY OF NEW YORK

# **PETUNJUK API**

**( Fire Indicator )**



**Risiko Rendah ( Low Risk )**



**Risiko Sederhana ( Medium Risk )**

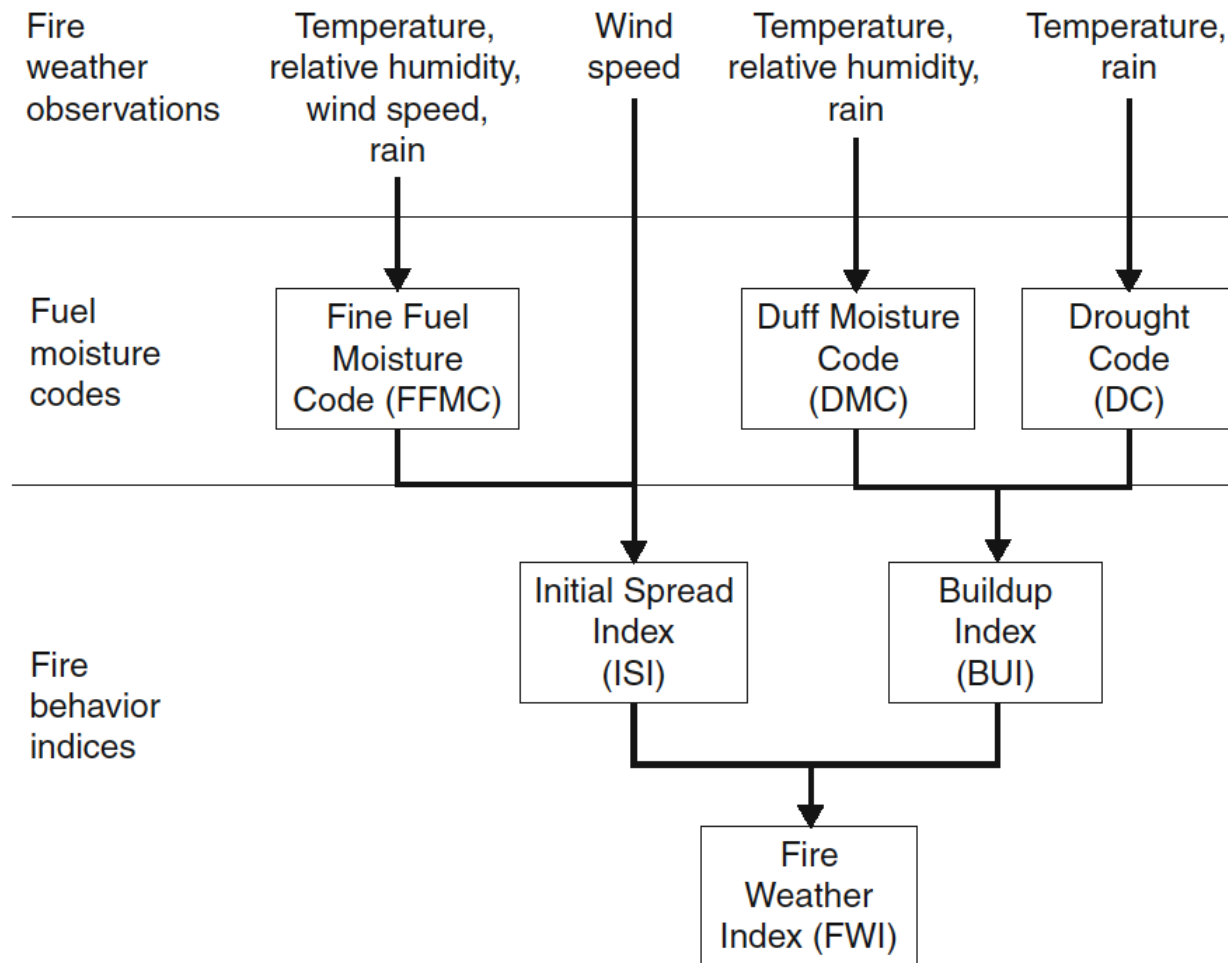


**Risiko Tinggi ( High Risk )**



**Risiko Berbahaya ( Extreme Risk )**

# The Fire Weather Index System



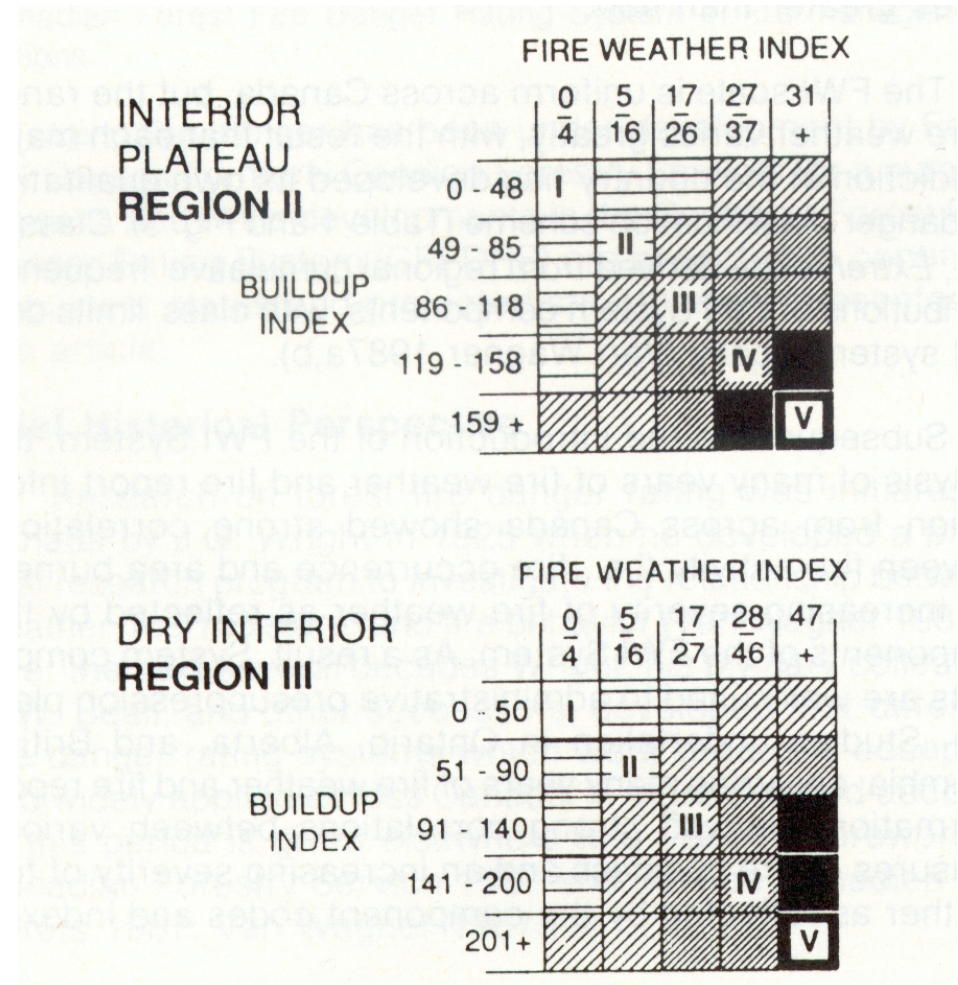
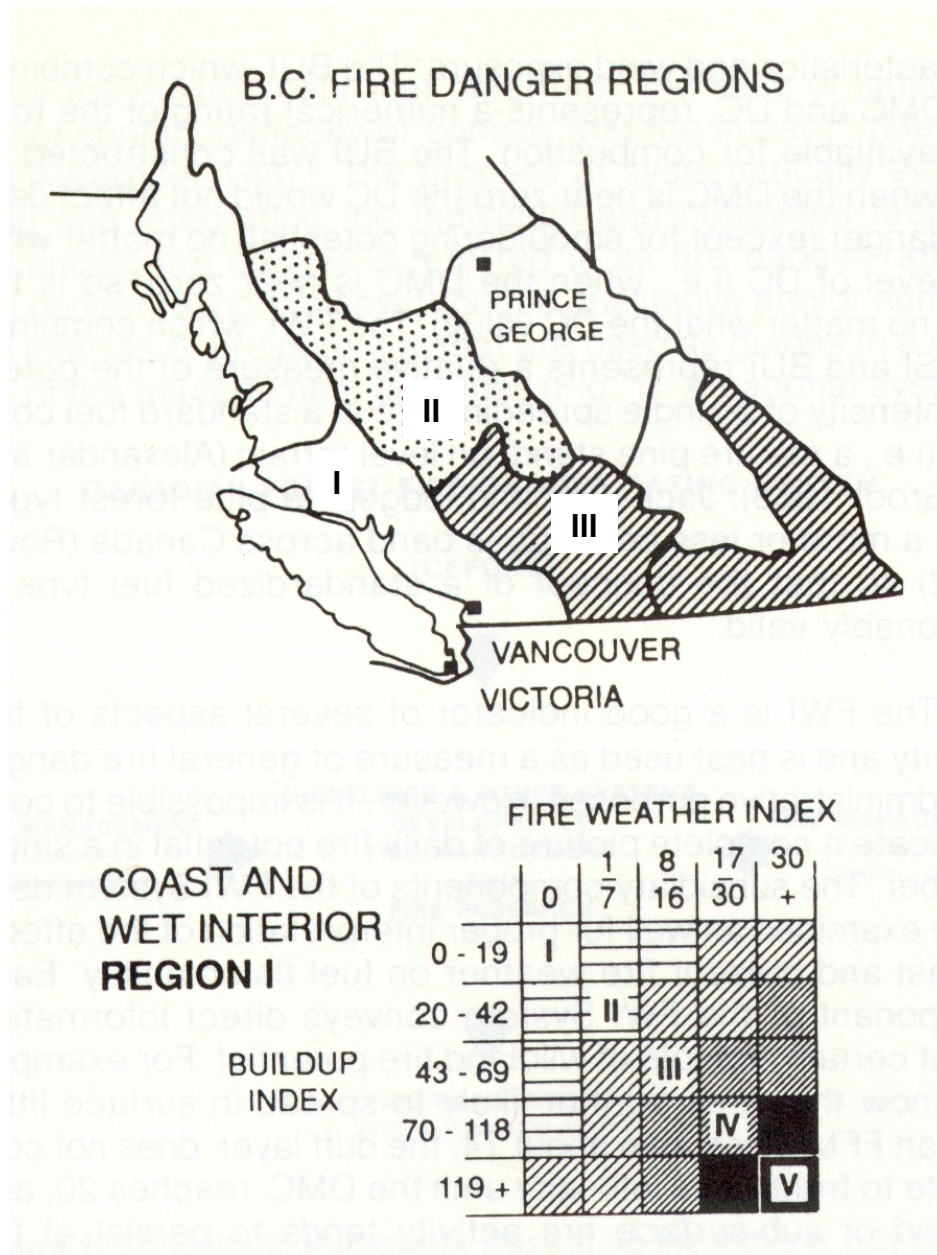
de Groot, W. J., and M. D. Flannigan (2014), Climate Change and Early Warning Systems for Wildland Fire, in Reducing Disaster: Early Warning Systems for Climate Change, edited by Z. Zommers and A. Singh, pp. 127-151, Springer, Dordrecht, doi:10.1007/978-94-017-8598-3.



# Fire Danger Classification Scheme

## Used in British Columbia

(Richard Carr, Canadian Forest Service)





# The Fire Weather Index System is most widely used fire danger rating system in the world.

**Table 7.2** Summary of commonly referenced weather-based systems and indexes for national fire danger rating (documented systems only)

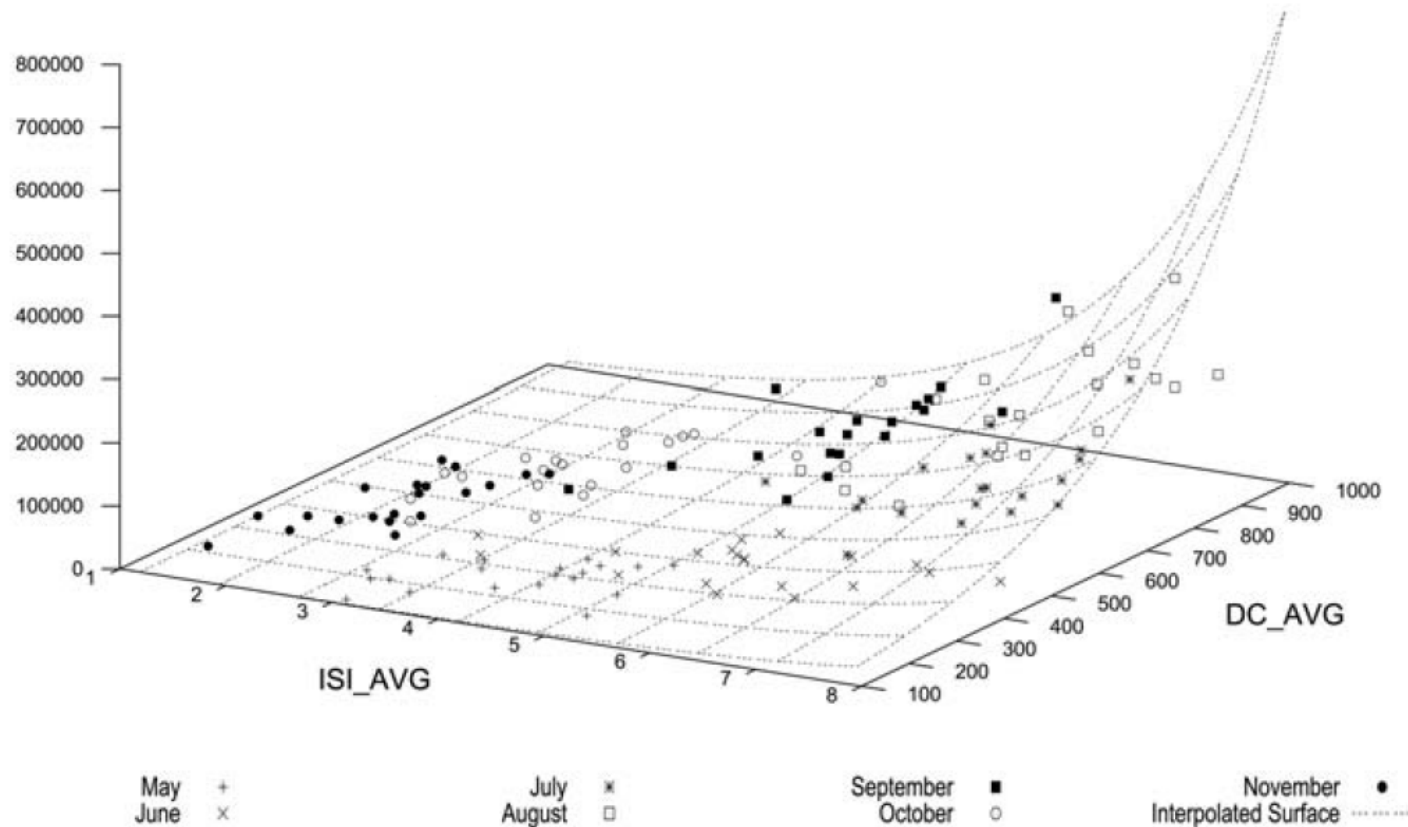
Index or system	Country or region of application <sup>a</sup>	Weather parameters	References
Canadian Forest Fire Weather Index System	Argentina, Canada, China, Chile, Fiji, Indonesia, Malaysia, Mexico, New Zealand, Portugal, South Africa, Spain, Sweden, Thailand, United Kingdom, USA (Alaska, some northern states), Venezuela; Europe and North Africa, Eurasia, global, Southeast Asia, Southern Africa	Temperature, rainfall amount, relative humidity, wind speed	Van Wagner ( <a href="#">1987</a> )

de Groot, W. J., and M. D. Flannigan (2014), Climate Change and Early Warning Systems for Wildland Fire, in Reducing Disaster: Early Warning Systems for Climate Change, edited by Z. Zommers and A. Singh, pp. 127-151, Springer, Dordrecht, doi:10.1007/978-94-017-8598-3.

# Example: Mediterranean Europe

## Burned area from large (>500ha) fires, 1985-2004

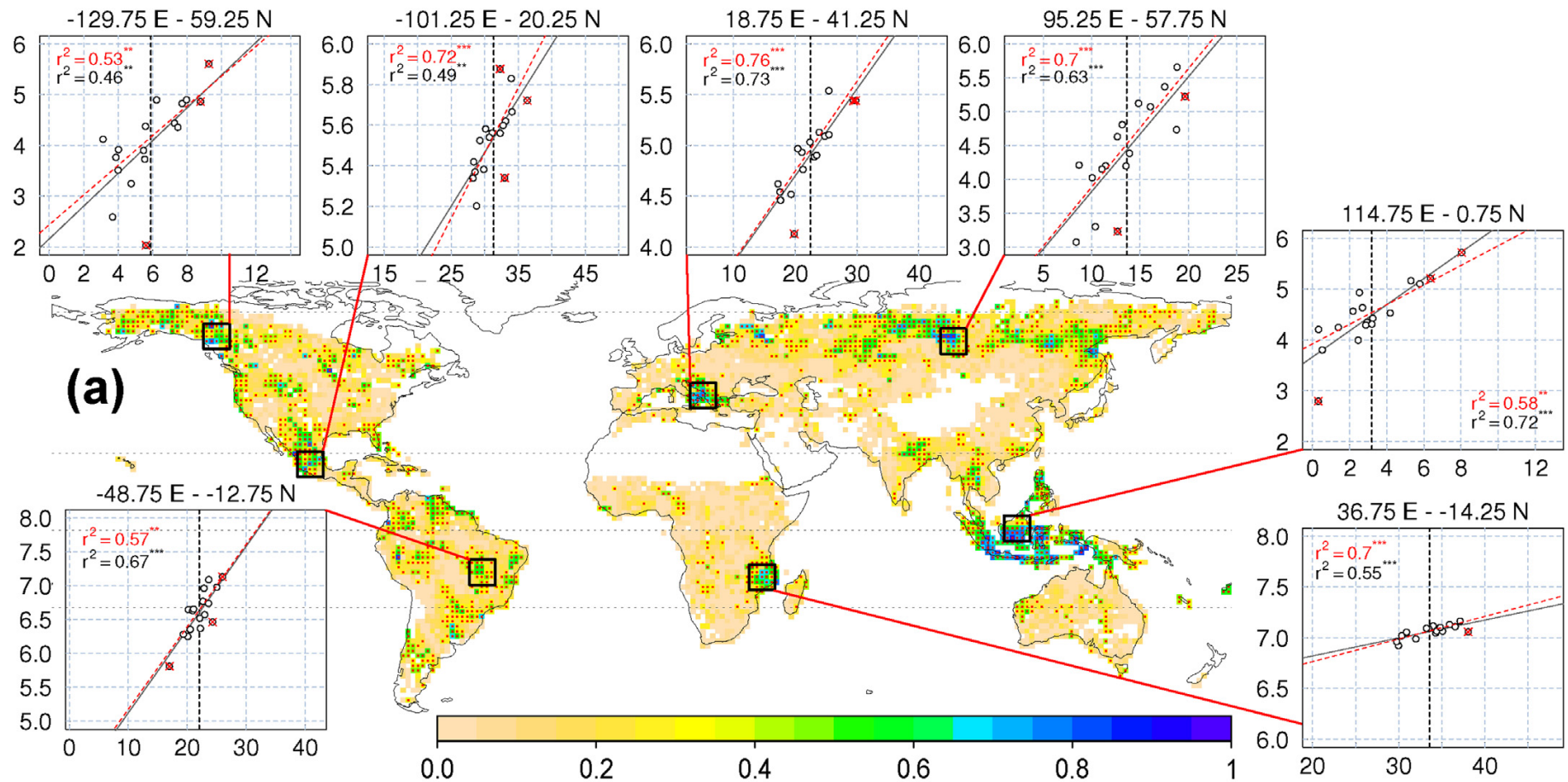
Burned Area (ha)



Camia, A., and G. Amatulli (2009), Weather Factors and Fire Danger in the Mediterranean, in *Earth Observation of Wildland Fires in Mediterranean Ecosystems*, edited by E. Chuvieco, pp. 71-82, Springer-Verlag, Berlin, doi:10.1007/978-3-642-01754-4\_6.



# Local fire weather vs. fire activity 1997-2013



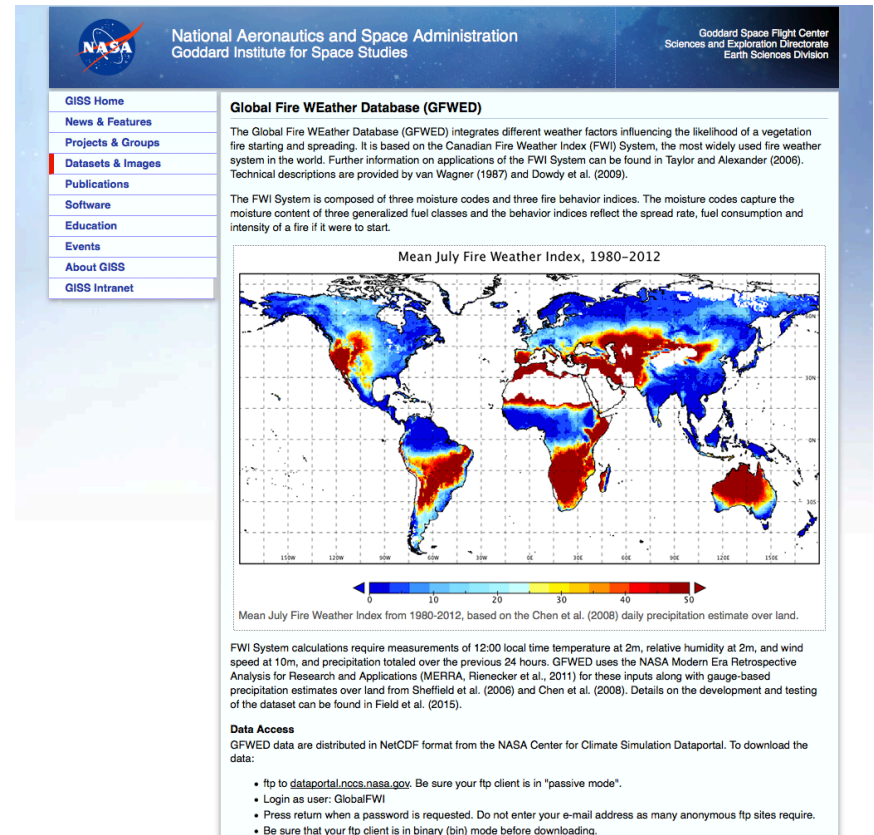
Bedia et al. (2015, *Ag. For. Met.*)

# Global Fire Weather Database

<http://data.giss.nasa.gov/impacts/gfwed>

Intended:

- As a baseline for operational FWI use in new regions.
- For understanding meteorological drivers of fire activity anywhere in the world.
- For analysis of large-scale controls of fire weather.



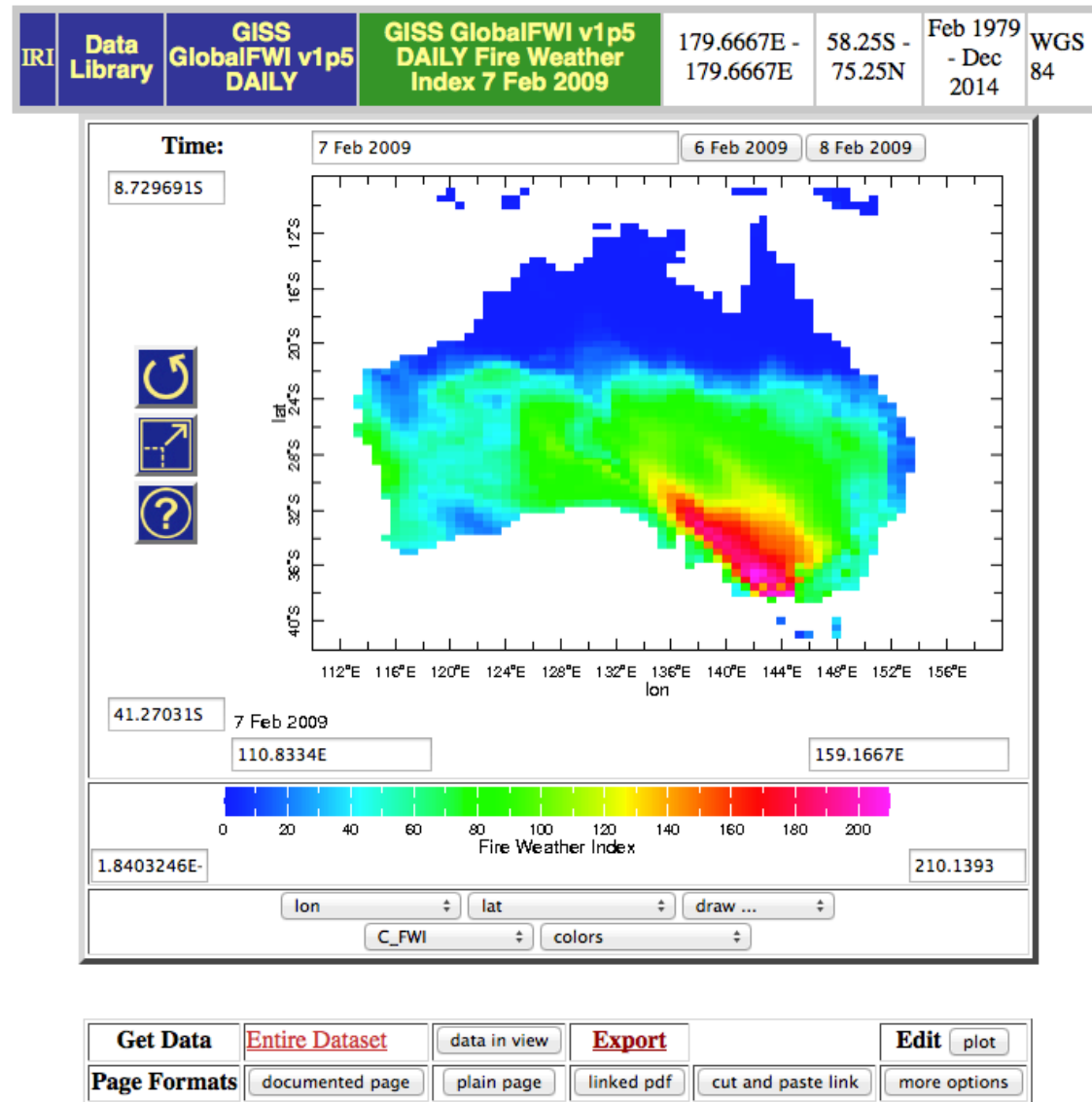


# Eight different versions

	<u>Data source</u>	<u>Period</u>	<u>Latency</u>	<u>Coverage</u>	<u>Nominal Resolution</u>
T, RH, wind-speed, snow depth	MERRA2	1981-Present	~ 2 mo.	Global	0.5° x 2/3°
Precipitation	1. MERRA2 raw precipitation	1981-Present	~ 2 mo.	Global	0.5° x 2/3°
	2. MERRA2 bias-corrected precipitation	1981-Present	~ 2 mo.	Global	0.5° x 2/3°
	3. Sheffield / Princeton precipitation	1981-2010	4+years	Global	0.5° x 0.5°
	4. NCEP CPC gauge-based precipitation	1981-Present	1 day	Global	0.5° x 0.5°
	5. GPCP 1-degree-daily v1.2	1997-Present	6+ mo.	Global	1.0° x 1.0°
	6. TRMM 3B42	1998-2014	N/A	50°S - 50°N	0.25° x 0.25°
	7. GPM IMERG v03 - Final	20140401-Present	5 + mo.	60°S - 60°N	0.1° x 0.1°
	8. GPM IMERG v03 - Late	20150401-Present	1 day	60°S - 60°N	0.1° x 0.1°

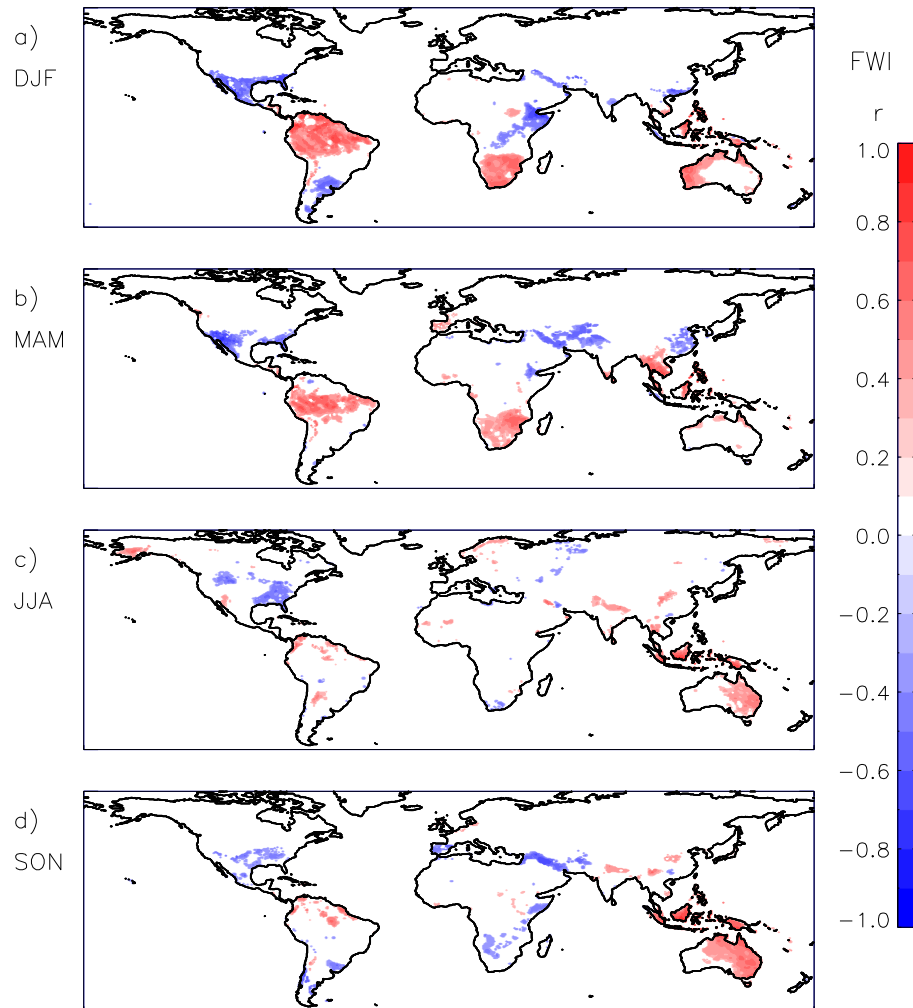
# FWI on February 7 2009 in SE Australia, Black Saturday

Generated from Columbia IRI Data Library





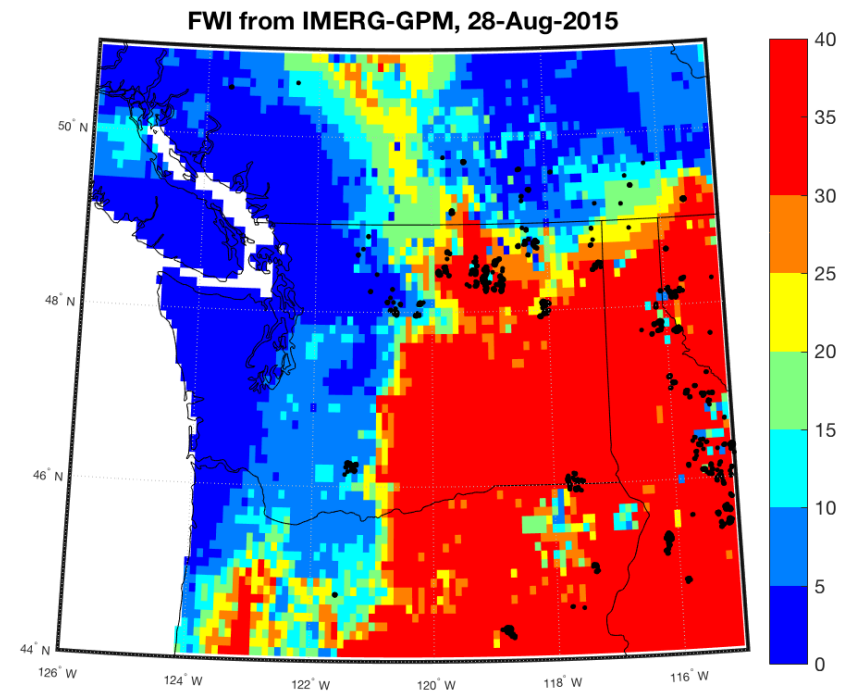
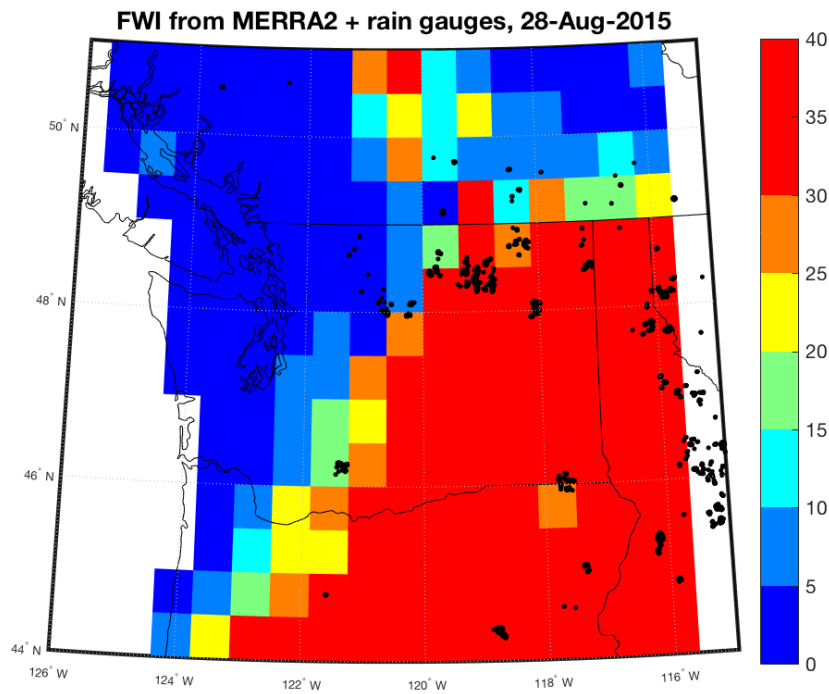
# ENSO influences on fire weather



FWI correlation with Nino 3.4, 1980-2012  
(Andrew Dowdy, Australian BoM)

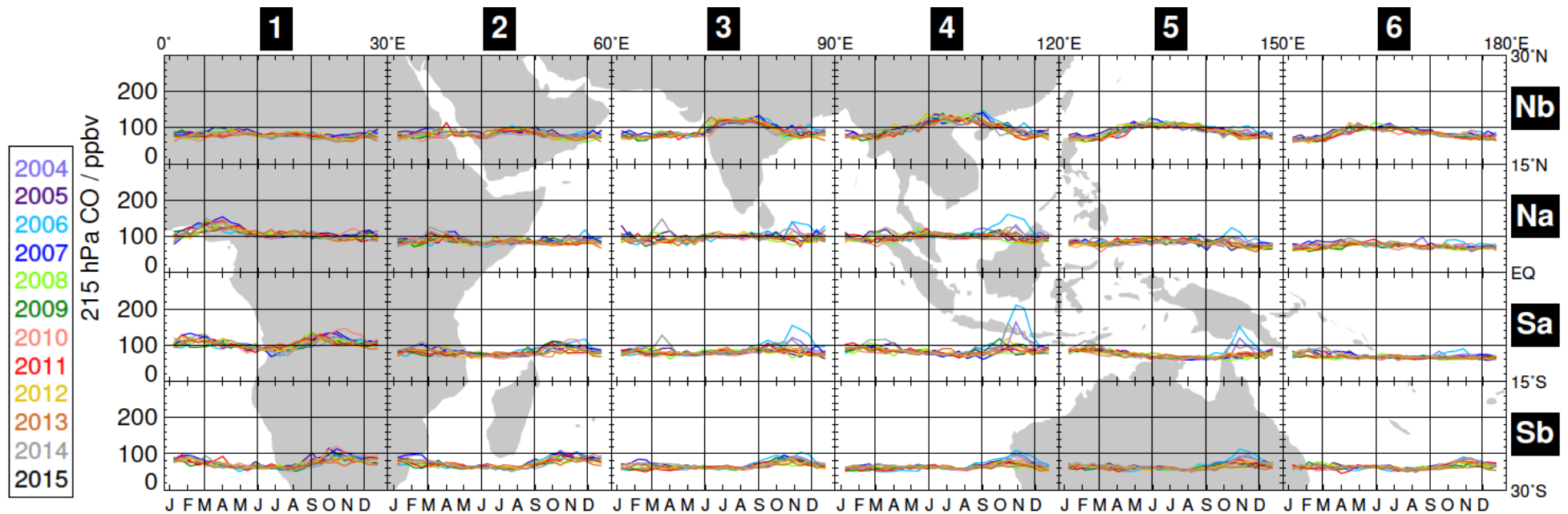
# Record-breaking 2015 fires in Pacific Northwest

Fire Weather Index w/ Aqua & Terra MODIS active fires



With Ruth Engel, Miriam Marlier, Dennis Lettenmaier, UCLA

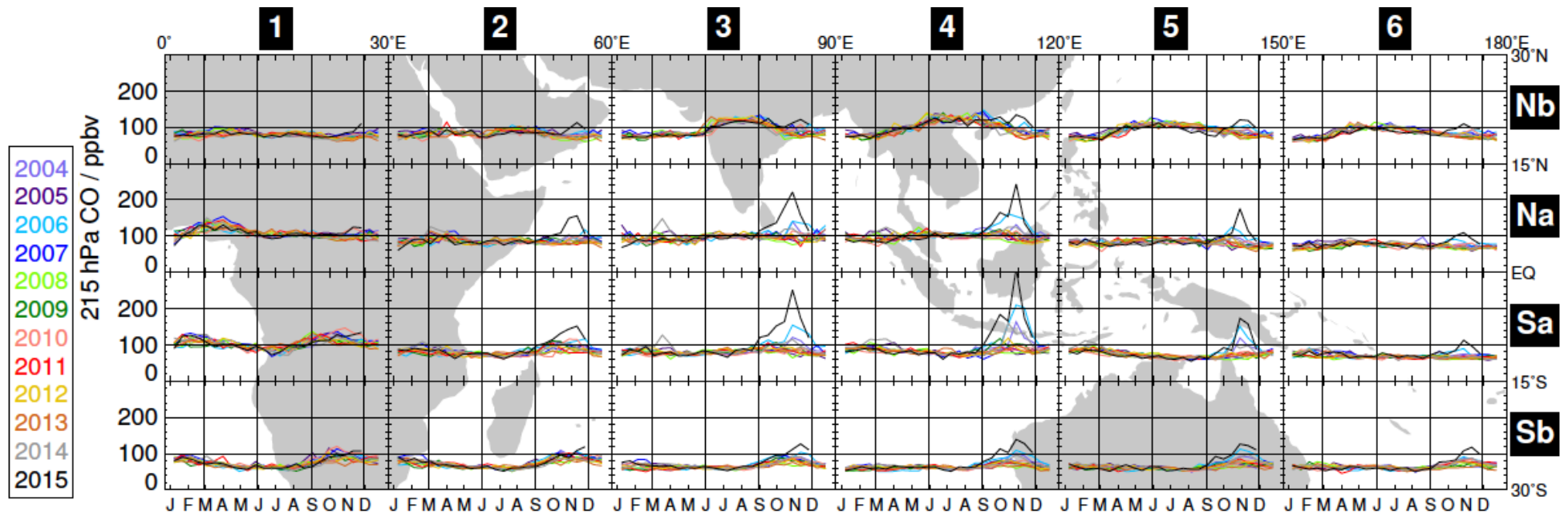
# Aura MLS upper tropospheric CO



Field et al. (2016, *PNAS*)



# 2015 CO highest during mission due to El Niño-induced drought and biomass burning in Indonesia

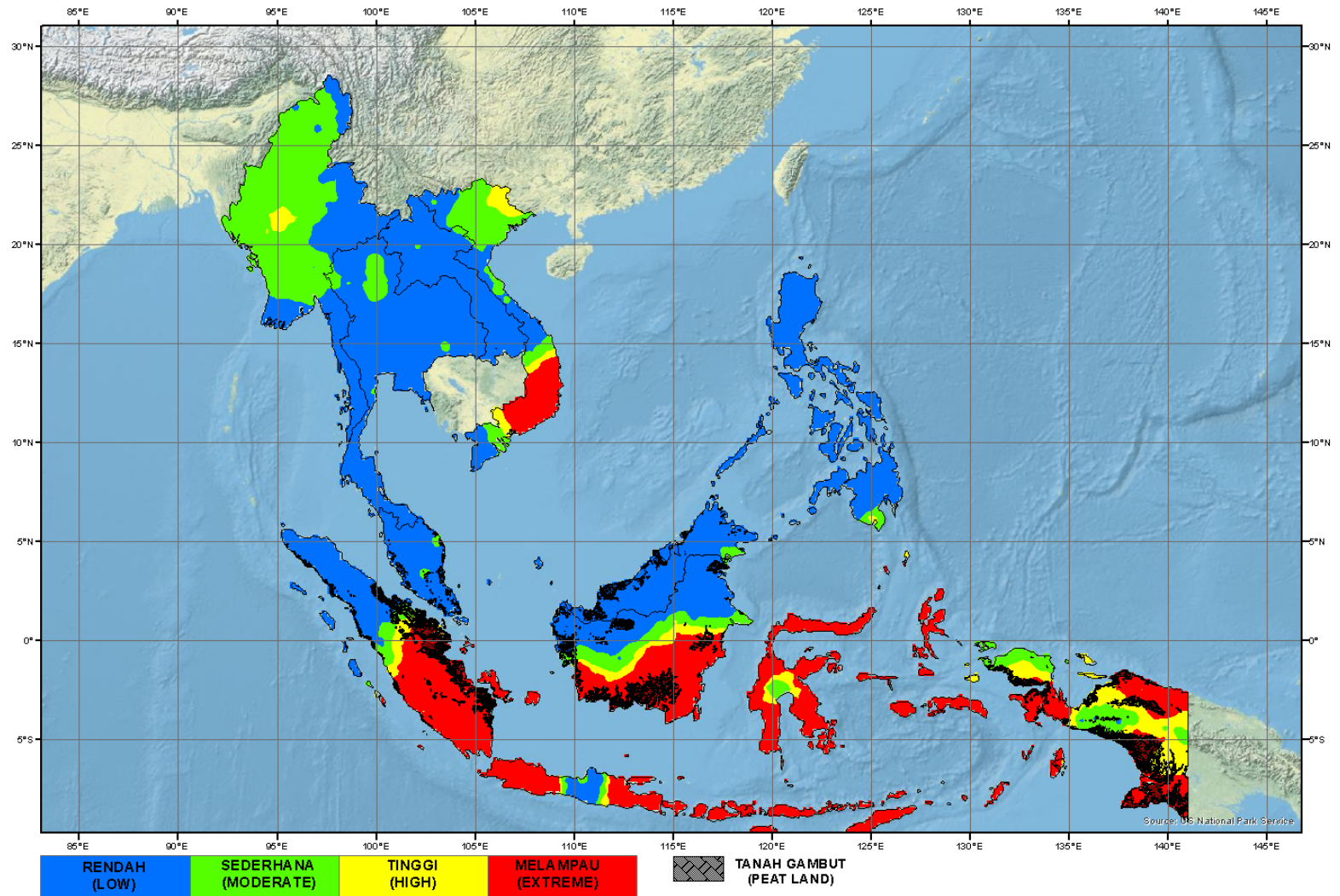


Field et al. (2016, *PNAS*)

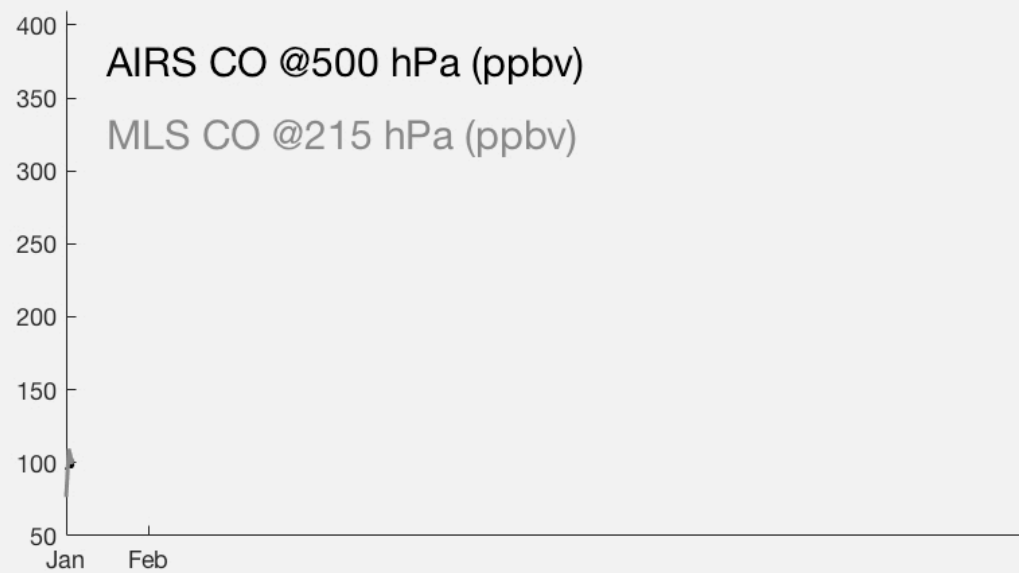
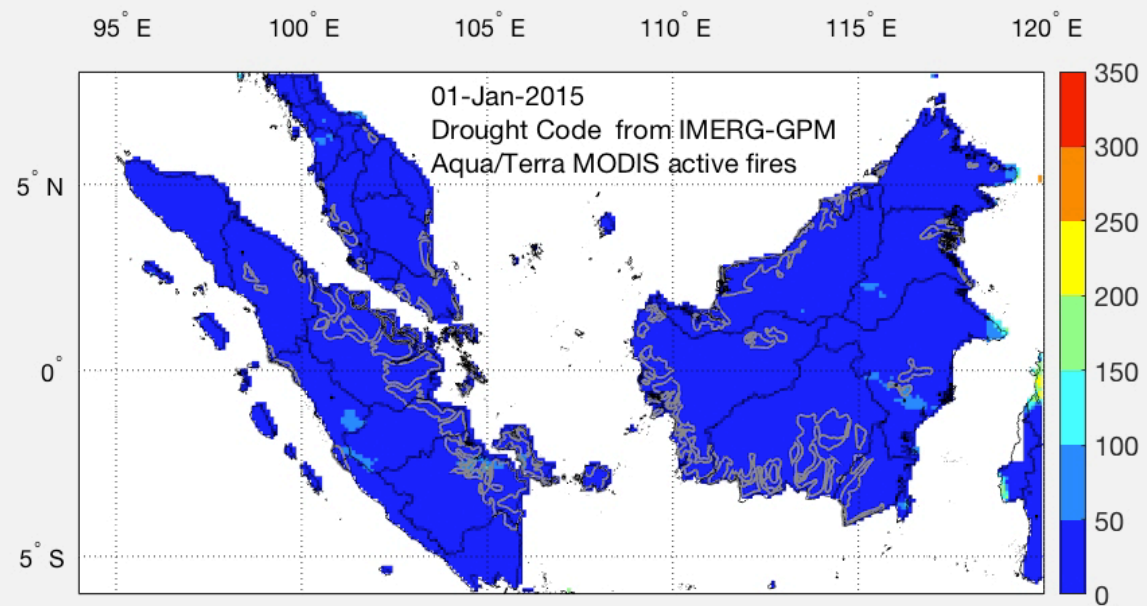
# KOD KEMARAU

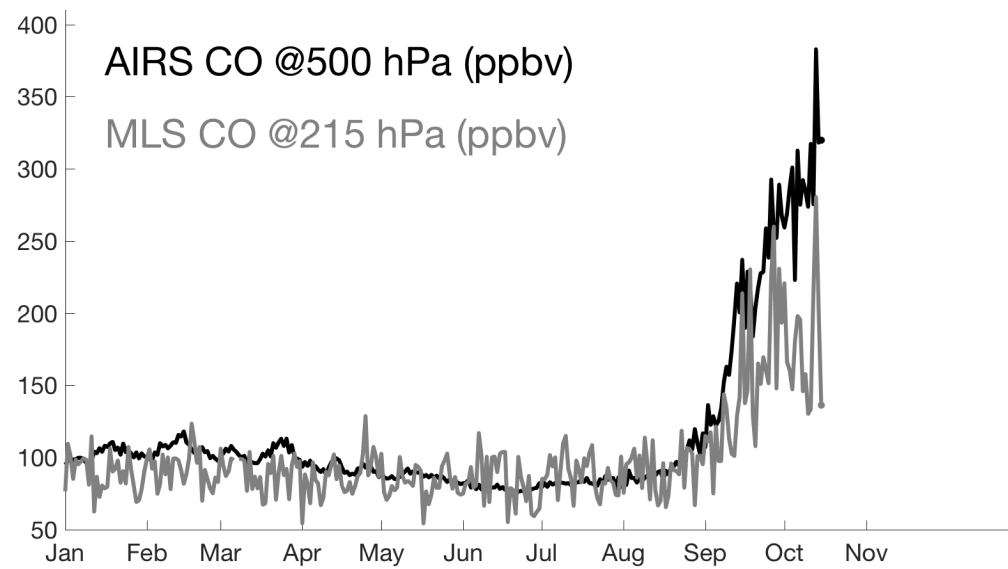
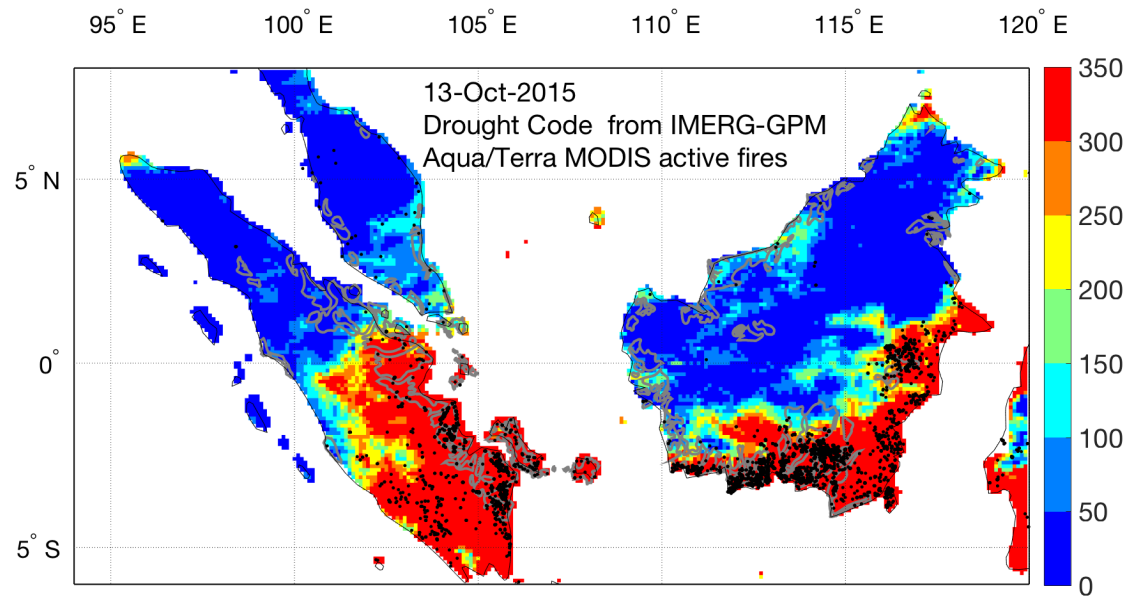
DROUGHT CODE (DC)

27-10-2015



DC categories from de Groot et al. (2005, *Miti. Adap. Strat. Glob. Change.*)







# GFWED development priorities

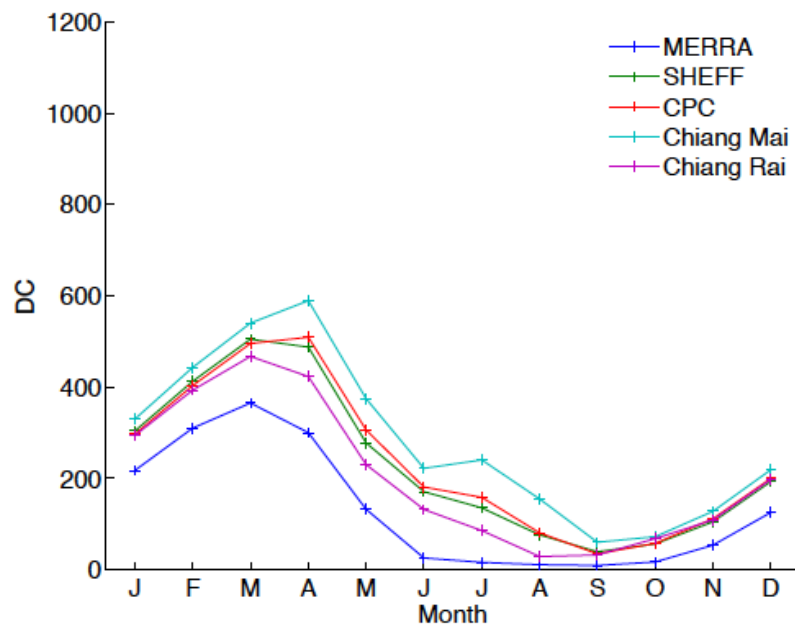
- Evaluation of gridded products against fire weather calculations from non-assimilated surface weather data.
- Evaluation of light rainfall, which influences fine-fuel moisture content, which influences conditions under which fires can start.
- Addition of US NFDRS components.
- Improved snow-cover estimates and high-latitude startup procedures.
- NRT products using GEOS-5 analysis fields, possibly forecasts.
- NRT adoption by fire management agencies – with development partners?
- More online and visualization access.
- Late 2017 wildfire prediction conference at Columbia Univ. / LDEO under Extreme Wx initiative.



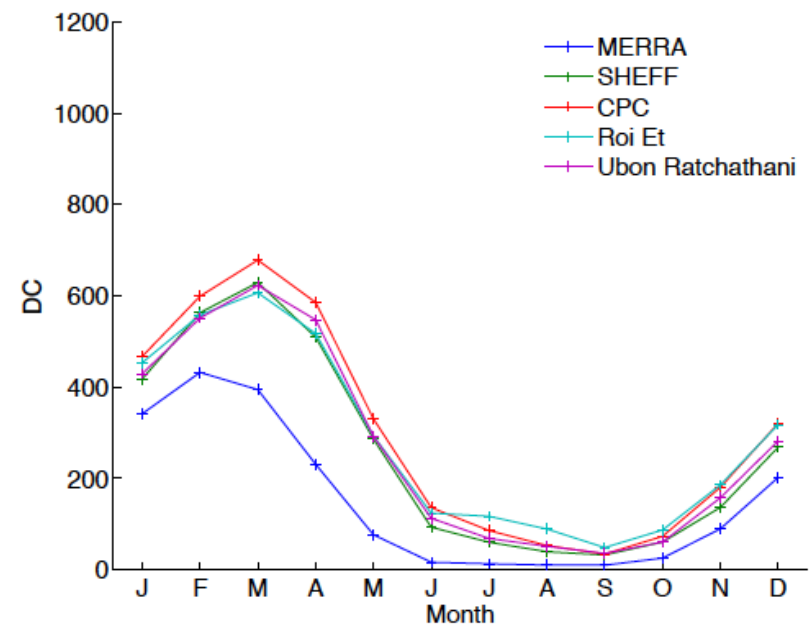
# Drought Code seasonality over Thailand

Strongly dependent on precipitation estimate

Northern Thailand



Eastern Thailand



Field et al. (2015, *NHESS*)

# Record-breaking 2015 fires in Pacific Northwest

FWI from MERRA2 + rain gauges, 01-Jan-2015



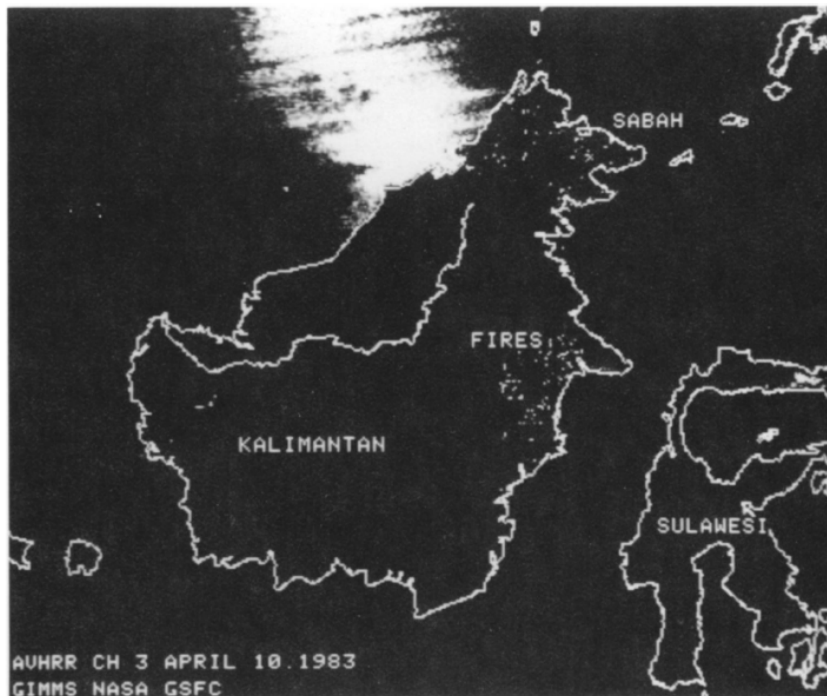
FWI from IMERG-GPM, 01-Jan-2015



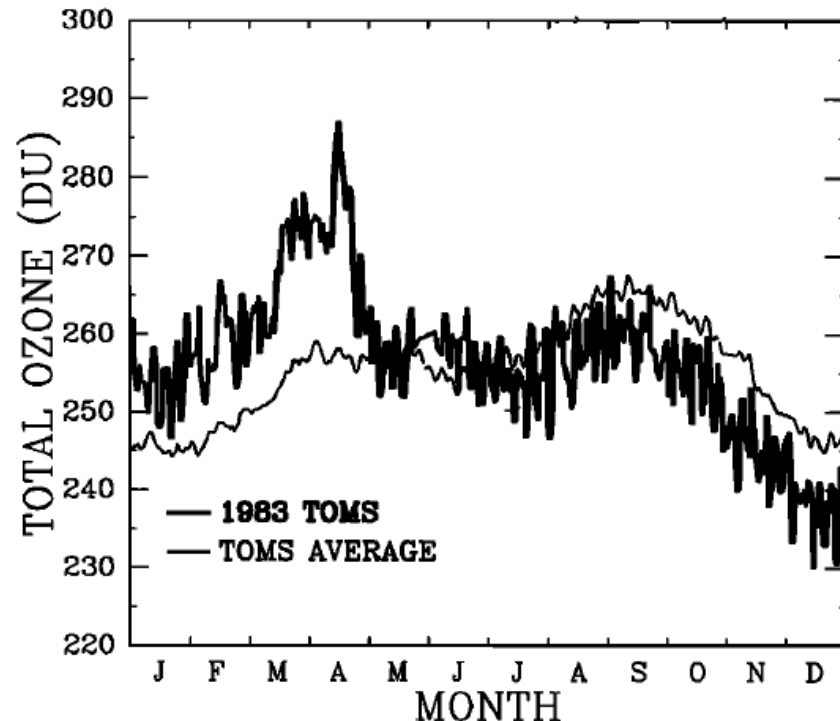


## Example: 1983 fires in Borneo

The first (?) large-scale fires in Indonesia and Malaysia to be described quantitatively in the literature.



Malingreau et al. (1985, *Ambio*)

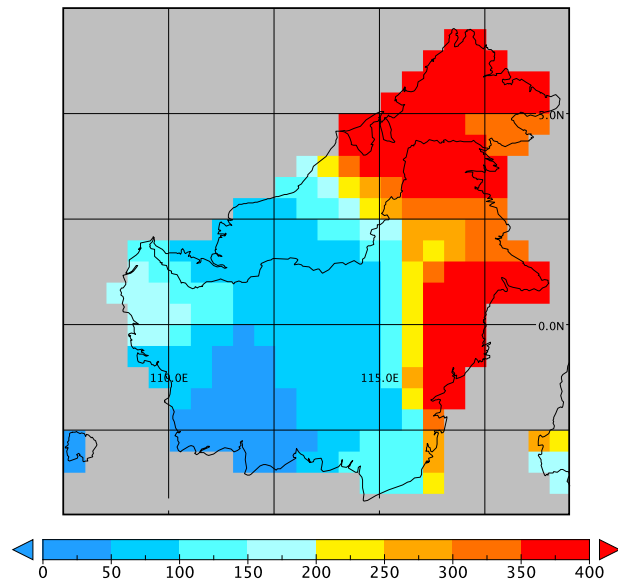


Fishman et al. (1990, *JGR*)

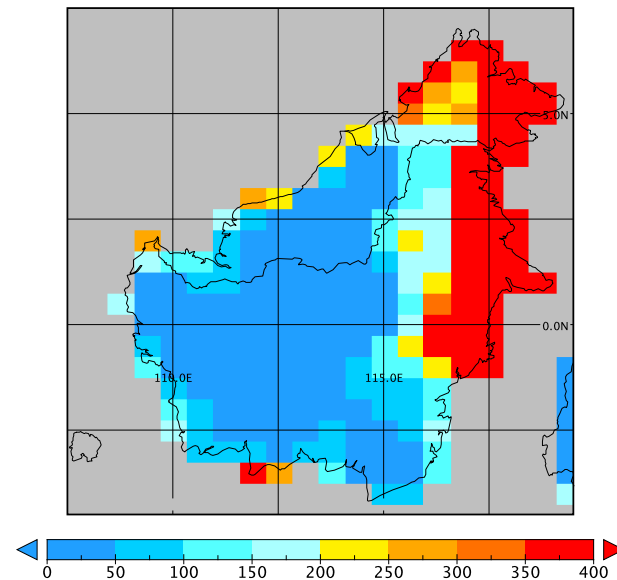
A prelude to later disasters.

# GFWED estimates capture these conditions

Drought Code from CPC rain gauges



Drought Code from uncorrected MERRA2



DC > 300 threshold based on 1994 and 1997 events (de Groot et al., 2007, MITI)

# Peak of the 1988 Yellowstone fires 150 000 acres burned

August 20, 1988 Fire Weather Index departure from long term average

